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LISTS OF SPECIES

Faunal richness and the checklist of Indian mosquitoes (Diptera: Culicidae)

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ABSTRACT: A review of published studies revealed that the Indian mosquito fauna comprises 393 species in 49 genera and 41 subgenera. The subfamily Anophelinae contains 61 species in one genus followed by Culicinae with 332 species in 11 tribes and 48 genera. The tribe Aedini (subfamily Culicinae) contains the highest number of species (176 species in 33 genera and two groups of *incertae sedis*; *i.e.*, "*Aedes*" *sensu auctorum* and "*Ochlerotatus*" *sensu auctorum*). With the recent taxonomic changes in tribe Aedini, the Indian mosquito genera have gone up from 22 to 49. Changes to the Indian Aedini fauna subsequent to the reclassification of tribe Aedini are discussed. A total of 31 species are currently recognized in India for transmitting various mosquito-borne agents of human diseases. A checklist for the Indian mosquito species is presented and the need for a comprehensive study is emphasized.

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INTRODUCTION

Mosquitoes, belonging to family Culicidae and order Diptera, are a large group of insects present throughout the temperate and tropical regions and even beyond the Arctic Circle of the world (Harbach 2007). The Oriental Region, which includes India, is regarded as one of the richest biogeographic regions for mosquitoes of the world, along with the Neotropics (Gaston and Hudson 1994). At present, a total of 3,540 recognized mosquito species, divided between two subfamilies and 112 genera, are recorded in the world (Harbach 2014). A three to five-fold increase of the present numbers can be foreseen with more discoveries and naming of sibling species mainly in *Anopheles,* as a result of application of DNA-based methods (Harbach 2007). India is ranked fifth in terms of mosquito biodiversity after Brazil, Indonesia, Malaysia and Thailand (Foley *et al*. 2007). After the monumental works of Christophers (1933) and Barraud (1934), not many comprehensive biosystematics studies of Indian Culicidae have been undertaken. Since that time, many changes have taken place in the mosquito taxonomic literature. However, in the absence of any up-to-date monograph on Indian Culicidae, entomologists in India are still compelled to use these two books. In this context, as mentioned by Reuben *et al*. (1993), it needs to be emphasized that publications of the Southeast Asian Mosquito Project are very useful for the identification of Indian mosquito species. Berlin (1972) rightly proposed for a systematic study of Indian Culicidae because of increasing mosquito-borne diseases, changing ecology and advances in mosquito systematics. The online systematic catalog of Culicidae listed 356 species in India (Gaffigan *et al*. 2014). Although fewer in numbers, since the 1980s some faunistic surveys carried out in various parts of India detected many species which are new additions to the mosquito fauna of India. It seems that some of these records did not reach the mosquito catalog. As such, an up-to-date check list of mosquitoes of India is still not available, and the actual number of species present in India, has to be approximated. Moreover, with the advancement of molecular biology, many researchers from non-entomology backgrounds are now working with mosquitoes, and there is confusion about the informal taxonomic series, groups and subgroups to which mosquito species belong. Confusion seems to have increased after the changes made to the classification of tribe Aedini (Reinert *et al*. 2004, 2006, 2008, 2009) as journals are using two systems of classification. Reclassification of the tribe Aedini brought major changes raising the number of genera in this tribe from 11 to 81 along with changes to the spelling of names of some species in accordance with provisions of the *International Code of Zoological Nomenclature*. Hence, a checklist seems essential for the entomologists and public health personnel working in India to reflect changes to nomenclature to promote familiarity with the new names. Considering this, an up-to-date check list of the mosquito species of India based on the current classification is provided. The present status of the mosquito fauna of India and need for future work are also discussed.

MATERIALS AND METHODS

Information was collected from two online resource databases, namely systematic catalog of Culicidae and mosquito taxonomic inventory and published materials

mainly since the 1980s (Bhattacharyya *et al*. 2000, 2002, 2003, 2004a, 2004b, 2005, 2007, 2008, 2009; Khan *et al*. 1998; Rajavel and Natarajan 2006, 2011; Rajavel *et al*. 1998, 2004, 2005a, 2005b, 2005c, 2005d, 2011; Rajput and Singh 1987a, 1987b, 1987c, 1989, 1990; Reuben *et al*. 1993; Tewari *et al*. 1987; Tewari and Hiriyan 1991, 1992, 1995). The systematic catalog of Culicidae provides information on country occurrence records of mosquito species. The mosquito taxonomic inventory contains up-to-date information on world Culicidae. The internal classification of genera *Anopheles*, *Culex*, *Verrallina* and *Uranotaenia* are available in the website of mosquito taxonomic inventory, which is followed here for the Indian mosquito fauna belonging to these genera. Recent abbreviations of generic and subgeneric names provided by Reinert (2009a) are followed here. The authorship of generic and species names is provided in the check list (Appendix 1).

Results and Discussion

Records indicate that the Indian mosquito fauna includes 393 species divided among 49 genera and 41 subgenera. Subfamily Anophelinae contains 61 species in one genus followed by subfamily Culicinae with 332 species in 11 tribes and 48 genera. Tribe Aedini of subfamily Culicinae contains the highest number of species (176 species in 33 genera and two groups of *incertae sedis, i.e., "Aedes" sensu auctorum*, "*Ochlerotatus*" *sensu auctorum*) (Table 1). The check list of the Indian Culicidae is presented as Appendix 1. In India, 31 species are currently recognized for transmitting various mosquito-borne pathogens; these are listed in Table 2.

Subfamily Anophelinae: Subfamily Anophelinae has three genera globally. Indian species are confined to genus *Anopheles,* with 61 formally named species divided between subgenera *Anopheles* and *Cellia*. However, the number of species will increase with the naming or recognition of synonymous names of sibling species in several groups or complexes. In India, subgenus *Anopheles* contains 26 species. In this subgenus, the assemblage of species in two most important groups (Hyrcanus and Barbirostris Groups) is still uncertain in India. The Hyrcanus Group is a highly complex group, which includes 30 closely related species distributed widely in the Oriental and Palaearctic regions, with some species playing important role in transmission of malaria and filariasis (Ma and Xu 2005). This Group was also incriminated as a vector of Japanese encephalitis in India and neighboring countries. Only seven species of this Group were recorded from India in comparison to 25 species recorded in China (Ma *et al*. 1998, 2000a, 2000b). Morphological identification of these species in adult stage seems to be very difficult or impossible unless accompanied by associated immature skins (Harrison and Scanlon 1975). Many anopheline surveys carried out in India recorded *An. nigerrimus* of Hyrcanus Group to be the most predominant, seemingly because their identification was based on adult stage (Malhotra *et al*. 1987; Nagpal and Sharma 1987). However, surveys carried out in north-east India and Western Ghats of South India, where species identification was done using adult as well as associated larval and pupal characters, recorded *An. peditaeniatus* to be the most prevalent and *An. nigerrimus* as rather uncommon species (Khan *et al*. 1998; Tewari *et al*. 1987). Immature surveys carried out in upper Brahmaputra valley detected *An. crawfordi*, *An. paraliae*, *An. peditaeniatus* and *An. sinensis* of Hyrcanus Group from the north-east India, but did not collect any specimen of *An. nigerrimus* (Khan *et al*. 1998). A few specimens identified as *An. paraliae* in these surveys were collected as immatures from a forest fringe area of Assam. Earlier considered as a subspecies of *An. lesteri*, *An. paraliae* was later elevated to species status by Harrison *et al*. (1990), but more recently it has been synonymyzed with *lesteri* by Taai *et al*. (2013), hence it is listed as *lesteri* here. However, distribution of this species is restricted to low elevation coastal areas of Malaysia, Brunei, Vietnam and Thailand (Harrison and Scanlon 1975). This species is also easily misidentified with *An. pursati*. Hence, record of this species in India needs further investigation, incorporating DNA-based analysis similar to China, where, ITS2 marker of r-DNA was used to differentiate member species of *An. hyrcanus* group (Ma *et al*. 1998, 2000a, 2000b). Recently, ITS2 sequencing of some specimens of Hyrcanus Group confirmed the presence of *An. crawfordi*, *An. peditaeniatus* and *An. sinensis* in the north-east India (Regional Medical Research Centre, Dibrugarh, Assam, India; unpublished data). Similarly Barbirostris Group which includes 11 species globally also has uncertain distribution records for most of the species, particularly in Indonesia and Indian sub-region, mainly because of identification difficulties (Harrison and Scanlon 1975). Four species were recognized in this group from India. *An. hodgkini* was detected from Assam during larval collections (Khan *et al.* 1998).

Subgenus *Cellia* containing 35 species encompasses all important vectors of human malaria in India. Recently, two new species have been described from this subgenus from India. *An. pseudosundaicus* belonging to Pyretophorus Series was described from coastal areas of Kerela (Tyagi *et al*. 2009). Another species belonging to Maculatus Group of the Neocellia Series named as *An. krishnai* was described (Sathe and Jagtap 2012). However, Harbach (2014) noted the lack of credible evidence to support the recognition of this proposed species. Hence, *krishnai* is regarded as *nomen nudum* and is not included in our list of Indian *Anopheles*. *Anopheles dthali* and *Anopheles superpictus* have been known only from extreme north-west (Baluchistan) which is not part of India. They have also not been recorded subsequently in India and therefore not included in the present checklist.

Several anopheline taxa recognized earlier to be medically important are now found to be complexes or groups of morphologically indistinguishable species (Rattanarithikul *et al*. 2006). Some important complexes and groups recorded in India are, *An. annularis* (species A and B), *An. culicifacies* (species A, B, C, D and E), *An. dirus* (species X), *An. fluviatilis* (species S, T, U and V), *An. subpictus* (species A, B, C, and D) and the *An. sundaicus* (cytotype D) complexes (Walton *et al*. 1999; WHO 2007). With the advances in mosquito taxonomy several species belonging to such groups or complexes are now formally named. *An. maculatus,* recognized as one such species group, includes nine formally named species (Harbach 2014; Somboon *et al*. 2011). A recent study revealed the

TABLE 1 Member species of Culicidae in India.

SUBFAMILY	TRIBE	GENUS	SUBGENUS	NUMBER OF SPECIES
Anophelinae		*Anopheles*	*Anopheles*	26
			Cellia	35
Culicinae	Aedeomyiini	*Aedeomyia*	*Aedeomyia*	1
	Aedini	*"Aedes" sensu auctorum*		4
		Aedimorphus		15
		Armigeres	*Armigeres*	9
			Leicesteria	11
		Ayurakitia		1
		Bruceharrisonius		4
		Christophersiomyia		4
		Cancraedes		2
		Collessius	*Collessius*	3
			Alloeomyia	1
		Danielsia		2
		Dendroskusea		5
		Downsiomyia		6
		Edwardsaedes		1
		Finlaya		2
		Fredwardsius		1
		Gilesius		1
		Himalaius		2
		Heizmannia	*Heizmannia*	11
			Mattinglyia	2
		Hopkinsius	*Yamada*	1
		Hulecoeteomyia		5
		Jihlienius		1
		Kenknightia		2
		Lorrainea		2
		Mucidus	*Mucidus*	3
		Neomelaniconion		1
		Ochlerotatus		1
		"Ochlerotatus" sensu auctorum	*"Finlaya" sensu auctorum*	5
		Paraedes		4
		Petermattinglyius	*Petermattinglyius*	2
		Phagomyia		11
		Rhinoskusea		3
		Scutomyia		1
		Stegomyia	*Actinothrix*	2
			Heteraspidion	2
			Huangmyia	2
			Stegomyia	1
			Xyele	1
			Without subgenus	11
		Tewarius		3
		Udaya		2
		Verrallina	*Harbachius*	4
			Neomacleaya	16
			Verrallina	3
	Culicini	*Culex*	*Culex*	23
			Culiciomyia	9
			Eumelanomyia	10
			Lophoceraomyia	28
			Maillotia	1
			Oculeomyia	6
		Lutzia	*Metalutzia*	4
	Culisetini	*Culiseta*	*Allotheobaldia*	1
			Culiseta	2
	Ficalbiini	*Ficalbia*		1
		Mimomyia	*Etorleptiomyia*	1
			Mimomyia	4
			Ingramia	1
	Hodgesiini	*Hodgesia*		1
	Mansoniini	*Coquilletidia*	*Coquilletidia*	3
		Mansonia	*Mansonioides*	4
	Orthopodomyiini	*Orthopodomyia*		5
	Sebethini	*Malaya*		2
		Topomyia	*Suaymyia*	1
			Topomyia	3
		Tripteroides	*Rachionotomyia*	5
			Tripteroides	3
	Toxorhynchitini	*Toxorhynchites*	*Toxorhynchites*	9
	Uranotaeniini	*Uranotaenia*	*Pseudoficalbia*	15
			Uranotaenia	13
Total of each taxnomomic level				
2	11	49 + 2 *sensu auctorum*	41 + 1 *sensu auctorum*	393

presence of six member species of the Maculatus Group in the north-east India, with detection of *An. rampae* constituting a new country record (Singh *et al*. 2012). Such studies may be extended to other areas where Maculatus Group is present. Similarly, species X of the Dirus Complex, reported earlier from Yunnan province of China, was also detected in Haflong area of Assam in the north-east India (Prakash *et al*. 2010).

Subfamily Culicinae: Subfamily Culicinae is comprised of 332 species divided into 11 tribes and 48 genera in India.

Tribe Aedeomyiini: A single genus *Aedeomyia* is included in this tribe. This genus is not listed in the mosquito catalog under the Indian mosquito fauna. However, Tyson (1970) reported Andaman Islands as one of the distribution localities for *Aedeomyia catastica*. This species was also reported from mainland India from Assam and Western Ghats (Khan *et al*. 1998; Reuben *et al*. 1993) and in the mangrove forests of Sunderbans, West Bengal (Rajavel *et al*. 2005a).

Tribe Aedini: In the earlier classification the tribe Aedini contained 11 genera (Knight and Stone 1977 and its supplements). Recent reclassification of this tribe has raised the number of genera to 81 (Reinert *et al.* 2004, 2006, 2008, 2009). Reinert (1999, 2000a) earlier resurrected *Verrallina* and *Ayurakitia* to generic rank. Revision of tribe Aedini resulted in the elevation of many former subgenera of *Aedes* to generic status (Reinert *et al*. 2004). *Downsiomyia* was elevated to genus level from synonymy with *Finlaya*. Further examination and revision of *Finlaya* and allied taxa and *Ochlerotatus* and allied taxa (Reinert *et al*. 2006, 2008), followed by comprehensive phylogenetic study of tribe Aedini (Reinert *et al*. 2009) resulted in recognition of more genera and rearrangement of taxa.

As per the current classification, Indian fauna of tribe Aedini includes 176 species in 33 genera and two groups of *incertae sedis* species (*"Aedes" sensu auctorum*- 4 and *"Ochlerotatus" sensu auctorum*- 5). Indian species belonging to subgenus *Finlaya* genus *Aedes* are now placed in 12 genera (*Bruceharrisonius, Collessius, Downsiomyia, Danielsia, Finlaya, Gilesius*, *Hopkinsius, Hulecoeteomyia, Himalaius, Jihlienius, Ochlerotatus* and *Phagomyia*). Similarly species of the subgenus *Diceromyia* of India are now placed in three genera *Dendroskusea, Petermattinglyius* and *Tewarius.* Illustrated keys of these new genera present in Thailand were provided by Rattanarithikul *et al*. (2010). Further details are available in the website of mosquito taxonomic inventory. Kaur (2003) provided updated distribution maps of Indian Aedini fauna.

Genus *Aedimorphus*: Earlier recognized as a subgenus of genus *Aedes, Aedimorphus* is now elevated to generic rank (Reinert *et al*. 2009). Mostly Oriental in distribution, of the 67 species recognized in this genus, 15 species were recorded from India.

Genus *Armigeres*: Distributed mainly in the Oriental region and also in the Palaearctic and Australasian regions, the genus *Armigeres* is represented by 20 species in India, between two subgenera *Armigeres* and *Leicesteria.* Rajput and Singh (1987c) reported the detection of *Ar. dolichocephalus* from Manipur state. *Ar. joloensis,* a rare mosquito species, was detected from upper Assam (Bhattacharyya *et al*. 2000). Recently a new species *Ar. mahantai* collected as immatures from endemic pitcher plant *Nepenthes khasiana* of Meghalaya state in the north-east India was described (Bhattacharyya *et al*. 2009). *Ar. pallithorax*, described from Yunnan, China was detected from Namsai, Arunachal Pradesh (Rajavel *et al*. 2011).

Genus *Ayurakitia*: This genus is represented by only two species detected from mountainous areas of western Thailand (Reinert 1972). Recently, occurrence of this genus was reported for the first time from India as larvae collected form *Pandanus* axils in Meghalaya, north-east India and reared to adults, were found to be *Ayurakitia peytoni* (Rajavel and Natarajan 2011).

Genus *Bruceharrisonius*: An earlier subgenus of genus *Ochlerotatus* (Reinert 2003) *Bruceharrisonius* was later elevated to generic rank (Reinert *et al*. 2006). This genus includes four species in India. Three species earlier in Aureostriatus Subgroup (Aureostriatus Group) and one species of Auronitens Subgroup (Alboannulatus Group) of subgenus *Finlaya* genus *Aedes* (Knight and Marks 1952) are now placed in genus *Bruceharrisonius*.

Genus *Christophersiomyia*: A former subgenus of genus *Aedes*, now elevated to generic rank (Reinert *et al*. 2004), *Christophersiomyia* includes five species, of which, four occur in India. *Cr. gombakensis,* reported for the first time from Western Ghats, is a new country record (Reuben *et al*. 1993).

Genus *Cancraedes*: *Cancraedes* was elevated to genus from former subgenus of *Aedes* (Reinert *et al*. 2009). Of the total ten species included in this genus from Oriental Region, only two species occur in India.

Genus *Collessius*: A newly recognized genus *Collessius* (Reinert *et al*. 2006) includes species formerly in Pseudotaeniatus Subgroup of Mediovittatus Group, subgenus *Finlaya* of genus *Aedes* (Knight and Marks 1952). In India this genus is represented by four species divided into two subgenera.

Genus *Danielsia*: *Danielsia* was elevated to generic rank from synonymy with *Finlaya* and included three taxa (Reinert 2009b). In India this genus is comprised of two species formerly in Albotaeniatus Subgroup of subgenus *Finlaya*, genus *Aedes*.

Genus *Dendroskusea*: All five species included in genus *Dendroskusea* are found in India. These species were earlier placed in subgenus *Diceromyia* of genus *Aedes*.

Genus *Downsiomyia*: *Downsiomyia* as a genus was resurrected from synonymy with *Finlaya* (Reinert *et al*. 2006; Reinert and Harbach 2006). This genus is represented by six species in India which were earlier placed in the Niveus Subgroup of subgenus *Finlaya.* The species *Do. nivea* (*Ae. niveus*) has been incriminated as a vector of diurnally subperiodic *Wuchereria bancrofti* in the Nicobar islands (Tewari *et al*. 1995). Tewari and Hiriyan (1995) redescribed this species from Andaman and Nicobar Islands.

Genus *Edwardsaedes*: Comprising of three species, the genus *Edwardsaedes* is represented by only one species in India.

Genus *Finlaya*: In the earlier classification *Finlaya* was one of the largest subgenus of genus *Aedes* comprising of 42 species in India. However, in the current classification, the genus *Finlaya* includes species only from Kochi Group

of subgenus *Finlaya* (Reinert *et al*. 2004, 2006; Reinert and Harbach 2005). Two species of *Finlaya* are found in India. *Fl. flavipennis* was reported for the first time from mangrove forest ecosystem of Andaman and Nicobar Islands (Rajavel and Natarajan 2006).

Genus *Fredwardsius*: *Fredwardsius vittatus* is the only species included in this genus, which is present in India.

Genus *Gilesius*: Of the two species included in this genus, only one species occurs in India.

Genus *Heizmannia*: This genus is represented by 13 species in India, 11 species under subgenus *Heizmannia* and two species under subgenus *Mattinglyia*. Rajput and Singh (1987b) first reported the occurrence of *Hz. aureochaeta* in India from Manipur state. Similarly *Hz. chengi* was reported for the first time from Jeypore hill tracts of Orissa (Rajavel *et al*. 2005b).

Genus *Himalaius*: Two species representing this genus are found in India.

Genus *Hopkinsius*: *Hopkinsius* contains two subgenera, *Hopkinsius* and *Yamada*. Only one species belonging to subgenus *Yamada* occurs in India.

Genus *Hulecoeteomyia*: Reinert *et al*. (2006) resurrected *Hulecoeteomyia* to generic status from synonymy with *Finlaya*. Five species included in this genus from India were earlier placed in Chrysolineatus Subgroup of subgenus *Finlaya*.

Genus *Jihlienius*: Of the three species recognized in this genus, only one is found in India.

Genus *Kenknightia*: *Kenknightia* comprised of 12 species of which only two species represent this genus in India.

Genus *Lorrainea*: Presence of *Lo. amesii* and *Lo. fumidus* belonging to genus *Lorrainea* were first reported from India based on collections made in mangrove forests of Sundarbans, in West Bengal (Rajavel *et al*. 2005a), Bhitarkanika in Orissa (Rajavel *et al*. 2005c) and Andaman Nicobar Islands (Rajavel *et al*. 2004). Previously, species of this genus were reported from Thailand, Philippines and Solomon Islands.

Genus *Mucidus*: Reinert (2000b) earlier treated *Mucidus* as a subgenus of newly elevated genus *Ochlerotatus*. However, in the later classification *Mucidus* was elevated to generic rank (Reinert *et al*. 2004). Three species of *Mucidus* are known to exist in India. Confirmed occurrence of *Mu. laniger* was reported from two forest areas of Assam, north-east India (Bhattacharyya *et al*. 2005).

Genus *Neomelaniconion*: Mainly distributed in Afrotropical region, only one species *Neomelaniconion lineatopenne* represent this genus in the Oriental region including India.

Genus *Ochlerotatus*: This genus includes only one species in India.

Genus *Paraedes*: Subgenus of the genus *Aedes* in the earlier classification, *Paraedes* has been raised to genus level (Reinert *et al*. 2004) and is represented by four species in India. In this genus the confirmed presence of *Pr. ostentatio* was reported from a tropical forest zone of Dibrugarh district, Assam (Bhattacharyya *et al.* 2002). Barraud (1934) earlier reported this species from Malabar Coast of Kerela on the basis of female specimens. Reinert (1981) on resurrection of *Pr. chrysoscuta* from *Pr. ostentatio* considered Barraud's Indian record under distribution of *Pr. chrysoscuta*, but pointed that Mattingly (1958) questioned the records from India. Until evidence is available otherwise, we retain Barraud's record as *Pr. chrysoscuta* and include it in the present checklist.

Genus *Petermattinglyius*: *Petermattinglyius* comprises of two species in India. These two species were earlier placed in subgenus *Diceromyia*. *Pe. franciscoi* was reported for the first time from mangrove forest ecosystem of Orissa (Rajavel *et al*. 2005c).

Genus *Phagomyia*: *Phagomyia* was elevated to generic status from synonymy with *Finlaya* and includes species formerly in Gubernatoris Subgroup of subgenus *Finlaya* (Reinert *et al*. 2006). *Phagomyia* includes 11 species in

Table 2. Vectors of mosquito-borne diseases in India.

Malaria
Anopheles (*Cellia*) *culicifacies s.l.*
Anopheles (*Cellia*) *baimaii*
Anopheles (*Cellia*) *fluviatilis s.l.*
Anopheles (*Cellia*) *minimus s.l.*
Anopheles (*Cellia*) *stephensi*
Anopheles (*Cellia*) *sundaicus s.l.*
Anopheles (*Cellia*) *annularis s.l.*
Anopheles (*Cellia*) *jeyporiensis*
Anopheles (*Cellia*) *philippinensis*
Anopheles (*Cellia*) *nivipes*
Anopheles (*Cellia*) *varuna*
Anopheles (*Cellia*) *maculatus s.l.*
(WHO 2007; Bhattacharyya *et al.* 2010; Rao 1984)
Japanese encephalitis
Culex (*Culex*) *vishnui*
Culex (*Culex*) *pseudovishnui*
Culex (*Culex*) *tritaeniorhynchus*
Culex (*Culex*) *fuscocephala*
Culex (*Culex*) *quinquefasciatus*
Culex (*Culex*) *gelidus*
Culex (*Culex*) *whitmorei*
Culex (*Oculeomyia*) *bitaeniorhynchus*
Culex (*Oculeomyia*) *infula*
Culex (*Oculeomyia*) *epidesmus*
Anopheles (*Anopheles*) *barbirostris s.l.*
Anopheles (*Anopheles*) *peditaeniatus*
Anopheles (*Cellia*) *subpictus s.l.*
Mansonia (*Mansonioides*) *annulifera*
Mansonia (*Mansonioides*) *indiana*
Mansonia (*Mansonioides*) *uniformis*
(Kanojia 2007)
Dengue
Stegomyia (*Stegomyia*) *aegypti*
Stegomyia albopicta
(Kaul *et al.* 1998; Das *et al.* 2004)
Chikungunya
Stegomyia (*Stegomyia*) *aegypti*
Stegomyia albopicta
(Mourya *et al.* 2001)
West Nile
Culex (*Culex*) *vishnui*
Culex (*Culex*) *quinquefasciatus*
(Paramasivan *et al.* 2003)
Filariasis
Culex (*Culex*) *quinquefasciatus*
Mansonia (*Mansonioides*) *annulifera*
Mansonia (*Mansonioides*) *uniformis*
Downsiomyia nivea
(Agarwal and Sashindran 2006; Tewari *et al.* 1995)

India. *Ph. feegradei* was new addition to the mosquito fauna of India from the mangrove forest ecosystem of Orissa (Rajavel *et al*. 2005c).

Genus *Rhinoskusea*: *Rhinoskusea* comprises of three species in India. In this genus one new species *Rh. portonovoensis* was described from mangrove forest of the east coast (Tewari and Hiriyan 1991). The detection of *Rh. wardi* from mangrove forests of Andaman and Nicobar Islands is a new country record (Rajavel and Natarajan 2006). Reinert (2000b) earlier treated *Rhinoskusea* as a subgenus of genus *Ochlerotatus*. However, in the later classification *Rhinoskusea* was elevated to generic status (Reinert *et al*. 2004).

Genus *Scutomyia*: *Scutomyia* includes only one species in India.

Genus *Stegomyia*: The medically important genus *Stegomyia* includes 19 species in India. In this genus *St. krombeini,* earlier placed in Scutellaris Group of genus *Aedes* and subgenus *Stegomyia* (Huang 1979), was detected first from south India (Tewari *et al*. 1987) and later from north-east India (Bhattacharyya *et al*. 2008). Huang (1975) reported this species to be very common in Sri Lanka, which probably remained undetected as it was mistaken for another common species, *St. albopicta*. Hence careful observations during entomological surveys are necessary to differentiate *St. krombeini* from *St. albopicta*, especially in rural and forest areas of India. The records of *St. flavopicta* in Assam, western Himalayas and Coorg (Barraud 1934) was not considered by Huang (1972) who restricted its distribution to Japan and Korea. Its inclusion by Kaur (2003) in Indian species is based on Barraud (1934). While *St. pseudoalbopictus*, *St. subalbopictus* and *St. novalbopictus* have been recorded in collections made in several parts of the country, *St. flavopicta* has not been obtained and hence it is not included in the present checklist. At present of the eight new subgenera recognized for this genus, only eight Indian species are placed in five subgenera. Remaining 11 species under this genus are still without subgeneric placement.

Genus *Tewarius*: Of the four species included in this genus, three are found in India. Reinert (2006) placed *Te. agastyai, Te. reubenae* and *Te. nummatus* of subgenus *Diceromyia* to a new genus *Tewarius*. *Te. agastyai* and *Te. reubenae* were described from Western Ghats (Tewari and Hiriyan 1992).

Genus *Udaya*: *Udaya* includes three species from the Oriental region, of which two are found in India.

Genus *Verrallina*: Divided into three subgenera this genus contains 23 species in India. Subgenus *Neomacleaya* contains most of the species (16) followed by *Harbachius* (four) and *Verrallina* (three). A new species *Ve. assamensis* was described from Assam (Bhattacharyya *et al*. 2004a) and *Ve. consonensis* was recorded for the first time from Andaman and Nicobar Islands (Rajavel and Natarajan 2006). *Ve. ceylonica* was recently collected from Kerela state (Vector Control Research Centre, Puducherry, India unpublished report).

Incertae sedis species: Nine species belonging to two groups "*Aedes*" *sensu auctorum* and "*Ochlerotatus*" *sensu auctorum,* regarded to be of uncertain taxonomic position, are now under this head. Though, not considered as their formal status, the genus and subgenus of these species are now kept as provided by the authors. Four new species of undetermined subgenus (*Aedes kolhapuriensis, Aedes sangitee*, *Aedes panchgangee* and *Aedes sangiti*) were described from Kolhapur district of Maharashtra (Girhe and Sathe 2001; Sathe and Girhe 2001). However, descriptions of these species were inadequate and mainly based on adult female characters. Comparisons with closely related species were not available in the descriptions. Hence, collections of all life stages may be required for comparing with other related species to establish their validity and placing them in relevant genera and subgenera. Genus *Aedes* is now restricted mainly in the Palaearctic and Nearctic Regions. We retained these species in the checklist as they were already in the list of mosquito catalog and mosquito taxonomic inventory. Similarly, five species retained in genus "*Ochlerotatus*" and subgenus "*Finlaya*" (*Oc. auronitens, Oc. oreophilus, Oc. sintoni, Oc. suffusus* and *Oc. versicolor*) are yet to be placed in relevant genera in the current classification.

Tribe Culicini: Culicini includes 81 species in two genera and seven subgenera in India.

Genus *Culex*: Genus *Culex* is represented by 77 species in six subgenera in India with *Lophoceraomyia* being the predominant subgenus with 28 species, followed by subgenus *Culex* with 23 species. This genus contains many important vectors of Japanese encephalitis (JE) virus and microfilariae in India. In subgenus *Culex*, Vishnui Subgroup contains three most important vectors (*Cx. tritaeniorhynchus, Cx. vishnui* and *Cx. pseudovishnui*) of JE in India. Presence of another three members in this subgroup i.e. *Cx. alienus*, *Cx. perplexus* and *Cx. whitei,* which can only be identified distinctively from other members on the basis of larval, pupal and male phallosome characters (Sirivanakarn 1976), can create diagnostic problem in JE vector surveillance in areas of their occurrence. Barraud (1934) earlier collected larvae of *Cx. whitei* from Haflong area of Assam. Few larvae of *Cx. alienus* which is regarded as one of the uncommon members by Sirivanakarn (1976) within this subgroup were collected from Assam. *Cx. perplexus* earlier known only from Andaman Islands was also reported from mangrove forests of Orissa (Rajavel *et al*. 2005c).

In subgenus *Culiciomyia,* Rajput and Singh (1987a) first reported *Cx. harrisoni* from Senapati district of Manipur. *Cx. spathifurca* was reported for the first time during a mosquito faunistic study in a mangrove forest ecosystem of Tamil Nadu (Rajavel *et al*. 1998). *Cx. scanloni* known earlier from Indonesia, Malaysia, Thailand and Vietnam was detected from Nagarhole National Park, Karnataka (Rajavel *et al*. 2011).

Subgenus *Eumelanomyia* is now represented by 10 species in India. One species *Cx. hinglungensis* was reported first time from Manipur state of India (Rajput and Singh 1989).

In subgenus *Lophoceraomyia* one new species *Cx. singhbhumensis* was described from Orissa (Natarajan and Rajavel 2009). Several other species were also recorded from various parts of India such as *Cx. lasiopalpis* and *Cx. pholeter* from south India (Reuben *et al*. 1993), *Cx. quadripalpis* from the northeast India (Bhattacharyya *et al*. 2003) and *Cx. pilifemoralis* and *Cx. wilfredi* from Jeypore hills, Orissa (Rajavel *et al*. 2005b), are new addition to

the mosquito fauna of India. Similarly *Cx. aculeatus, Cx. paraculeatus* and *Cx. gracicornis* from Assam, *Cx. cubitatus* from Andaman and Nicober Islands and *Cx. inculus* and *Cx. demissus* from Orissa are new country records (Rajavel *et al*. 2011). *Cx. wardi* previously known only from Sri Lanka was recently collected from Kerela state (Vector Control Research Centre, Puducherry, unpublished report).

The subgenus *Maillotia* is represented by only one species in India.

Tanaka (2004) resurrected *Oculeomyia* from synonymy as a new subgenus of genus *Culex*, which includes species earlier placed in the Bitaeniorhynchus Subgroup of subgenus *Culex*. This subgenus includes 6 species in India. Under this subgenus two females of *Cx. luzonensis* resting on vegetation were collected from Alwar, Rajasthan (Rajavel *et al*. 2011).

Genus *Lutzia*: It contains four species all in subgenus *Metalutzia*. A new species *Lt. agranensis* was described by Singh and Prakash (2008).

Tribe Culisetini: This tribe includes a single genus. Three species under two subgenera were recorded from India.

Tribe Ficalbiini: The tribe includes two genera i.e. *Ficalbia* and *Mimomyia*. One species of *Ficalbia* and six species of *Mimomyia* are found in India.

Tribe Hodgesiini: Tribe Hodgesiini includes a single genus and represented by only one species in India.

Tribe Mansoniini: Two genera are included in this tribe. The genus *Coquillettidia* includes three species and genus *Mansonia* is represented by four species in India.

Tribe Orthopodomyiini: Only one genus is included in this tribe which is represented by five species in India.

Tribe Sabethini: Sabethini includes 14 genera of which only three (*Malaya*, *Topomyia* and *Tripteroides*) are found in India. Genus *Malaya* is represented by two species and *Tripteroides* by eight species in India. Our experience indicates that genus *Tripteroides* requires further studies in India, especially in bamboo forested areas of the north-east India. Oriental in distribution (Thurman 1959), the genus *Topomyia* was represented by only one species in India, till Bhattacharyya *et al.* (2007) added three more species from Arunachal Pradesh. Further collections in high rainfall forested areas may increase the number of species in this genus.

Tribe Toxorhynchitini: Only one genus is included in this tribe. The genus *Toxorhynchites* includes nine species in India. *Tx. tyagii* is a new species described from Nilgiri hills, Western Ghats, southern India (Krishnamoorthy *et al*. 2013).

Tribe Uranotaeniini: *Uranotaenia* is the only genus in this tribe represented by 28 species (15 in subgenus *Pseudoficalbia* and 13 in subgenus *Uranotaenia*) in India. *Ur. micans* was first reported from India from Manipur state (Rajput and Singh 1990). Subsequently, *Ur. ohamai* was recorded from Western Ghats, South India (Reuben *et al*. 1993). *Ur. dibrugarhensis* is a new species described from Dibrugarh district of Assam (Bhattacharyya *et al*. 2004b). *Ur. rutherfordi* reported only from Sri Lanka was recently collected from Kerela state (Vector Control Research Centre, Puducherry, unpublished report).

At least 31 species are recognized in India for transmitting various pathogens to humans (Table 2). Mosquito taxonomy provides essential inputs for vector control. In Vietnam, non-vector species *An. varuna* was misidentified as *An. minimus* and targeted as vector (Bortel *et al* 2001). *An. fluviatilis,* a recognized primary vector of malaria in the north-east India (Mohapatra *et al*. 1998) is now found to be a seasonal variant of *An. minimus* (Singh *et al*. 2010). In respect of malaria vectors, Manguin *et al*. (2008) suggested that vector control in a region is dependent on the numbers and complexity of the primary and secondary vectors and hence, requires study of the whole anopheline fauna in order to integrate the diverse information about vector system to formulate appropriate and effective control strategy. Besides, sylvatic cycles of some unknown arboviruses capable of spreading to humans may thrive in our forest ecosystem. The history of Chikungunya virus available in the web resource database of Chikungunya Virus Net suggested this virus to be originally circulated in the sylvatic cycle between forest dwelling mosquitoes and non-human primates, has now spread to different parts of the world including India. These facts clearly signify the importance of mosquito fauna study.

Limited studies carried out in some parts of India since the 1980s detected several new species and many new country records. With the increasing mosquito borne diseases and changing ecology there is a need for the reassessment of Indian Culicidae fauna. Comprehensive surveys with the incorporation of DNA-based methods such as DNA barcoding of mosquitoes (Pradeep Kumer *et al*. 2007) need to be undertaken on a large scale.

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APPENDIX 1. Systematic checklist of mosquitoes of India.

Subfamily Anophelinae
Genus *Anopheles* Meigen, 1818
Subgenus *Anopheles* Meigen, 1818
ANGUSTICORN SECTION
Anopheles Series
Aitkenii Group
Anopheles (Anopheles) aitkenii James, 1903
Anopheles (Anopheles) bengalensis Puri, 1930
Anopheles (Anopheles) insulaeflorum (Swellengrebel & Swellengrebel de Graaf, 1920)
Anopheles (Anopheles) pinjaurensis Barraud, 1932
Culiciformis Group
Anopheles (Anopheles) culiciformis Cogill, 1903
Anopheles (Anopheles) sintoni Puri, 1929
Lindesayi Group
Gigas Complex
Anopheles (Anopheles) baileyi Edwards, 1929
Anopheles (Anopheles) gigas Giles, 1901
Lindesayi Complex
Anopheles (Anopheles) lindesayi Giles, 1900
Anopheles (Anopheles) nilgiricus Christophers, 1924
Plumbeus Group
Anopheles (Anopheles) barianensis James, 1911
Lophoscelomyia Series
Asiaticus Group
Anopheles (Anopheles) annandalei Prashad, 1918
Interruptus Subgroup
Anopheles (Anopheles) interruptus Puri, 1929
LATICORN SECTION
Myzorhynchus Series
Barbirostris Group
Barbirostris Subgroup
Anopheles (Anopheles) barbirostris van der Wulp, 1884
Anopheles (Anopheles) hodgkini Reid, 1962
Vanus Subgroup
Anopheles (Anopheles) ahomi Chowdhury, 1929
Anopheles (Anopheles) barbumbrosus Strickland & Chowdhury, 1927
Hyrcanus Group
Anopheles (Anopheles) argyropus (Swellengrebel, 1914)
Anopheles (Anopheles) sinensis Wiedemann, 1828
Lesteri Subgroup
Anopheles (Anopheles) crawfordi Reid, 1953
Anopheles (Anopheles) lesteri Baisas & Hu, 1936
Anopheles (Anopheles) peditaeniatus (Leicester, 1908)
Nigerrimus Subgroup
Anopheles (Anopheles) nigerrimus Giles, 1900
Anopheles (Anopheles) nitidus Harrison, Scanlon & Reid, 1973
Umbrosus Group
Letifer Subgroup
Anopheles (Anopheles) roperi Reid, 1950
Umbrosus Subgroup
Anopheles (Anopheles) umbrosus (Theobald, 1903)
Subgenus *Cellia* Theobald, 1902
Myzomyia Series
Anopheles (Cellia) majidi Young & Majid, 1928
Funestus Group
Anopheles (Cellia) jeyporiensis James, 1902
Aconitus Subgroup

Appendix 1. *Continued.*

Anopheles (Cellia) aconitus Donitz, 1902
Anopheles (Cellia) varuna Iyengar, 1924
Culicifacies Subgroup
Anopheles (Cellia) culicifacies Giles, 1901 (species A, B, C, D and E)
Minimus Subgroup
Fluviatilis Complex
Anopheles (Cellia) fluviatilis James, 1902 (species S, T, U and V)
Minimus Complex
Anopheles (Cellia) minimus Theobald, 1901
Neocellia Series
Anopheles (Cellia) karwari (James, 1903)
Anopheles (Cellia) moghulensis Christophers, 1924
Anopheles (Cellia) pulcherrimus Theobald, 1902
Anopheles (Cellia) stephensi Liston, 1901
Anopheles (Cellia) theobaldi Giles, 1901
Annularis Group
Anopheles (Cellia) annularis van der Wulp, 1884 (species A and B)
Anopheles (Cellia) pallidus Theobald, 1901
Anopheles (Cellia) philippinensis Ludlow, 1902
Nivipes Complex
Anopheles (Cellia) nivipes (Theobald, 1903)
Jamesii Group
Anopheles (Cellia) jamesii Theobald, 1901
Anopheles (Cellia) pseudojamesi Strickland & Chowdhury, 1927
Anopheles (Cellia) splendidus Koidzumi, 1920
Maculatus group
Anopheles (Cellia) pseudowillmori (Theobald, 1910)
Anopheles (Cellia) willmori (James, 1903)
Maculatus Subgroup
Anopheles (Cellia) dravidicus Christophers, 1924
Anopheles (Cellia) maculatus Theobald, 1901
Sawadwongporni Subgroup
Anopheles (Cellia) sawadwongporni Rattanarithikul & Green, 1987
Anopheles (Cellia) rampae Harbach & Somboon, 2011
Neomyzomyia Series
Kochi Group
Anopheles (Cellia) kochi Donitz, 1901
Leucosphyrus Group
Hackeri Subgroup
Anopheles (Cellia) mirans Sallum & Peyton, 2005
Leucosphyrus Subgroup
Dirus complex
Anopheles (Cellia) baimaii Sallum & Peyton, 2005
Anopheles (Cellia) elegans (James, 1903)
Tessellatus Group
Anopheles (Cellia) tessellatus Theobald, 1901
Paramyzomyia Series
Cinereus Group
Anopheles (Cellia) turkhudi Liston, 1901
Pyretophorus Series
Anopheles (Cellia) pseudosundaicus (Tyagi, Hiriyan, Tewari, Ayanar, Samuel, Arunachalam, Paramsivam, Krishnamoorthy, Dhanajeyan, Leo & Rajendran, 2009)
Anopheles (Cellia) vagus Donitz, 1902
Subpictus complex
Anopheles (Cellia) subpictus Grassi, 1899 (species A, B, C and D)
Sundaicus Complex
Anopheles (Cellia) sundaicus (Rodenwaldt, 1925) (cytotype D)

Subfamily Culicinae
Tribe Aedeomyiini
Genus *Aedeomyia* Theobald, 1901
Subgenus *Aedeomyia* Theobald, 1901
Aedeomyia (*Aedeomyia*) *catastica* Knab, 1909
Tribe Aedini
Genus "*Aedes*" *sensu auctorum*
Aedes kolhapuriensis Sathe & Girhe, 2001
Aedes panchgangee Sathe & Girhe, 2001
Aedes sangitee Sathe & Girhe, 2001
Aedes sangiti Girhe & Sathe, 2001
Genus *Aedimorphus* Theobald, 1903
Aedimorphus alboscutellatus (Theobald, 1905)
Aedimorphus caecus (Theobald, 1901)
Aedimorphus culicinus (Edwards, 1922)
Aedimorphus jamesi (Edwards, 1914)
Aedimorphus lowisii (Theobald, 1910)
Aedimorphus nigrostriatus (Barraud, 1927)
Aedimorphus pallidostriatus (Theobald, 1907)
Aedimorphus pampangensis (Ludlow, 1905)
Aedimorphus pipersalatus (Giles, 1902)
Aedimorphus punctifemoris (Ludlow, 1921)
Aedimorphus stenoetrus (Theobald, 1907)

Appendix 1. *Continued.*

Aedimorphus syntheticus (Barraud, 1928)
Aedimorphus taeniorhynchoides (Christophers, 1911)
Aedimorphus trimaculatus (Theobald, 1905)
Aedimorphus vexans (Meigen, 1830)
Genus *Armigeres* Theobald, 1901
Subgenus *Armigeres* Theobald, 1901
Armigeres (*Armigeres*) *aureolineatus* (Leicester, 1908)
Armigeres (*Armigeres*) *durhami* (Edwards, 1917)
Armigeres (*Armigeres*) *joloensis* (Ludlow, 1904)
Armigeres (*Armigeres*) *kesseli* Ramalingam, 1987
Armigeres (*Armigeres*) *kuchingensis* Edwards, 1915
Armigeres (*Armigeres*) *mahantai* Bhattacharyya, Prakash, Mohapatra & Sarma, 2009
Armigeres (*Armigeres*) *pallithorax* Dong, Zhou & Dong, 2004
Armigeres (*Armigeres*) *subalbatus* (Coquillett, 1898)
Armigeres (*Armigeres*) *theobaldi* Barraud, 1934
Subgenus *Leicesteria* Theobald, 1904
Armigeres (*Leicesteria*) *annulipalpis* (Theobald, 1910)
Armigeres (*Leicesteria*) *annulitarsis* (Leicester, 1908)
Armigeres (*Leicesteria*) *cingulatus* (Leicester, 1908)
Armigeres (*Leicesteria*) *dentatus* Barraud, 1927
Armigeres (*Leicesteria*) *digitatus* (Edwards, 1914)
Armigeres (*Leicesteria*) *dolicocephalus* (Leicester, 1908)
Armigeres (*Leicesteria*) *flavus* (Leicester, 1908)
Armigeres (*Leicesteria*) *inchoatus* Barraud, 1927
Armigeres (*Leicesteria*) *longipalpis* (Leicester, 1904)
Armigeres (*Leicesteria*) *magnus* (Theobald, 1908)
Armigeres (*Leicesteria*) *omissus* (Edwards, 1914)
Genus *Ayurakitia* Thurman, 1954
Ayurakitia peytoni (Reinert, 1972)
Genus *Bruceharrisonius* Reinert, 2003
Bruceharrisonius aureostriatus (Doleschall, 1857)
Bruceharrisonius christophersi (Edwards, 1922)
Bruceharrisonius doonii (Wattal, Bhatia & Kalra, 1958)
Bruceharrisonius greenii (Theobald, 1903)
Genus *Christophersiomyia* Barraud, 1923
Christophersiomyia annulirostris (Theobald, 1905)
Christophersiomyia gombakensis (Mattingly, 1959)
Christophersiomyia ibis (Barraud, 1931)
Christophersiomyia thomsoni (Theobald, 1905)
Genus *Cancraedes* Edwards, 1929
Cancraedes cancricomes (Edwards, 1922)
Cancraedes simplex (Theobald, 1903)
Genus *Collessius* Reinert, Harbach & Kitching, 2006
Subgenus *Collessius* Reinert, Harbach & Kitching, 2006
Collessius (*Collessius*) *elsiae* (Barraud, 1923)
Collessius (*Collessius*) *macdougalli* (Edwards, 1922)
Collessius (*Collessius*) *shortti* (Barraud, 1923)
Subgenus *Alloeomyia* Reinert, Harbach & Kitching, 2008
Collessius (*Alloeomyia*) *pseudotaeniatus* (Giles, 1901)
Genus *Danielsia* Theobald, 1904
Danielsia albotaeniata (Leicester, 1904)
Danielsia lepchana (Barraud, 1923)
Genus *Dendroskusea* Edwards, 1929
Dendroskusea kanarensis (Edwards, 1934)
Dendroskusea micropterus (Giles, 1901)
Dendroskusea periskelata (Giles, 1902)
Dendroskusea ramachandrai (Reuben, 1967)
Dendroskusea reginae (Edwards, 1922)
Genus *Downsiomyia* Vargas, 1950
Downsiomyia albolateralis (Theobald, 1908)
Downsiomyia albonivea (Barraud, 1934)
Downsiomyia mohani (Knight, 1969)
Downsiomyia nivea (Ludlow, 1903)
Downsiomyia niveoides (Barraud, 1934)
Downsiomyia novonivea (Barraud, 1934)
Genus *Edwardsaedes* Belkin, 1962
Edwardsaedes imprimens (Walker, 1861)
Genus *Finlaya* Theobald, 1903
Finlaya flavipennis Giles, 1904
Finlaya poicilia Theobald, 1903
Genus *Fredwardsius* Reinert, 2000
Fredwardsius vittatus (Bigot, 1861)
Genus *Gilesius* Reinert, Harbach & Kitching, 2006
Gilesius pulchriventer (Giles, 1901)
Genus *Himalaius* Reinert, Harbach & Kitching, 2006
Himalaius gilli (Barraud, 1924)
Himalaius simlensis (Edwards, 1922)
Genus *Heizmannia* Ludlow, 1905
Subgenus *Heizmannia* Ludlow, 1905
Heizmannia (*Heizmannia*) *aureochaeta* (Leicester, 1908)

Appendix 1. *Continued.*

Heizmannia (*Heizmannia*) *chandi* Edwards, 1922
Heizmannia (*Heizmannia*) *chengi* Lien, 1968
Heizmannia (*Heizmannia*) *complex* (Theobald, 1910)
Heizmannia (*Heizmannia*) *covelli* Barraud, 1929
Heizmannia (*Heizmannia*) *funerea* (Leicester, 1908)
Heizmannia (*Heizmannia*) *greenii* (Theobald, 1905)
Heizmannia (*Heizmannia*) *himalayensis* Edwards, 1922
Heizmannia (*Heizmannia*) *indica* (Theobald, 1905)
Heizmannia (*Heizmannia*) *reidi* Mattingly, 1957
Heizmannia (*Heizmannia*) *viridis* Barraud, 1929

Subgenus *Mattinglyia* Lien, 1968
Heizmannia (*Mattinglyia*) *discrepans* (Edwards, 1922)
Heizmannia (*Mattinglyia*) *tripunctata* (Theobald, 1908)

Genus *Hopkinsius* Reinert, Harbach & Kitching, 2008
Subgenus *Yamada* Reinert, Harbach & Kitching, 1908
Hopkinsius (*Yamada*) *albocinctus* (Barraud, 1924)

Genus *Hulecoeteomyia* Theobald, 1904
Hulecoeteomyia chrysolineata (Theobald, 1907)
Hulecoeteomyia formosensis (Yamada, 1921)
Hulecoeteomyia harveyi (Barraud, 1923)
Hulecoeteomyia pallirostris (Edwards, 1922)
Hulecoeteomyia saxicola (Edwards, 1922)

Genus *Jihlienius* Reinert, Harbach & Kitching, 2006
Jihlienius unicinctus Edwards, 1922

Genus *Kenknightia* Reinert, 1990
Kenknightia dissimilis (Leicester, 1908)
Kenknightia karwari (Barraud, 1924)

Genus *Lorrainea* Belkin, 1962
Lorrainea amesii (Ludlow, 1903)
Lorrainea fumida (Edwards, 1928)

Genus *Mucidus* Theobald, 1901
Subgenus *Mucidus* Theobald, 1901
Mucidus (*Mucidus*) *laniger* (Wiedemann, 1820)
Mucidus (*Mucidus*) *quasiferinus* (Mattingly, 1961)
Mucidus (*Mucidus*) *scatophagoides* Theobald, 1901

Genus *Neomelaniconion* Newstead, 1907
Neomelaniconion lineatopenne (Ludlow, 1905)

Genus *Ochlerotatus* Lynch Arribalzaga, 1891
Unassigned to Subgenus
Ochlerotatus pullatus (Coquillett, 1904)

Genus "*Ochlerotatus*" *sensu auctorum*
Subgenus '*Finlaya*' *sensu auctorum*
Ochlerotatus (*Finlaya*) *auronitens* Edwards, 1922
Ochlerotatus (*Finlaya*) *oreophilus* Edwards, 1916
Ochlerotatus (*Finlaya*) *sintoni* (Barraud, 1924)
Ochlerotatus (*Finlaya*) *suffusus* (Edwards, 1922)
Ochlerotatus (*Finlaya*) *versicolor* (Barraud, 1924)

Genus *Paraedes* Edwards, 1934
Paraedes barraudi Edwards, 1934
Paraedes chrysoscuta (Theobald, 1910)
Paraedes menoni Mattingly, 1958
Paraedes ostentatio Leicester, 1908

Genus *Petermattinglyius* Reinert, Harbach & Kitching, 2009
Subgenus *Petermattinglyius* Reinert, Harbach & Kitching, 2009
Petermattinglyius (*Petermattinglyius*) *franciscoi* (Mattingly, 1959)
Petermattinglyius (*Petermattinglyius*) *iyengari* (Edwards, 1923)

Genus *Phagomyia* Theobald, 1905
Phagomyia assamensis (Theobald, 1908)
Phagomyia cacharana (Barraud, 1923)
Phagomyia cogilli (Edwards, 1922)
Phagomyia deccana (Barraud, 1923)
Phagomyia feegradei (Barraud, 1934)
Phagomyia gubernatoris (Giles, 1901)
Phagomyia inquinata Edwards, 1922
Phagomyia khazani (Edwards, 1922)
Phagomyia lophoventralis (Theobald, 1910)
Phagomyia prominens (Barraud, 1923)
Phagomyia stevensoni (Barraud, 1923)

Genus *Rhinoskusea* Edwards, 1929
Rhinoskusea longirostris (Leicester, 1908)
Rhinoskusea portonovoensis (Tewari & Hiriyan, 1992)
Rhinoskusea wardi (Reinert, 1976)

Genus *Scutomyia* Theobald, 1904
Scutomyia albolineata Theobald, 1904

Genus *Stegomyia* Theobald, 1901
Subgenus *Actinothrix* Reinert, Harbach & Kitching, 2009
Stegomyia (*Actinothrix*) *edwardsi* Barraud, 1923
Stegomyia (*Actinothrix*) *seampi* (Huang, 1974)

Subgenus *Heteraspidion* Reinert, Harbach & Kitching, 2009
Stegomyia (*Heteraspidion*) *annandalei* Theobald, 1910
Stegomyia (*Heteraspidion*) *craggy* Barraud, 1923

Appendix 1. *Continued.*

Subgenus *Huangmyia* Reinert, Harbach & Kitching, 2009
Stegomyia (*Huangmyia*) *mediopunctata* Theobald, 1905
Stegomyia (*Huangmyia*) *perplexa* Leicester, 1908
Subgenus *Stegomyia* Theobald, 1901
Stegomyia (*Stegomyia*) *aegypti* (Linnaeus, 1762)
Subgenus *Xyele* Reinert, Harbach & Kitching, 2006
Stegomyia (*Xyele*) *desmotes* Giles, 1904
Species without subgeneric placement
Stegomyia w-alba Theobald, 1905
Stegomyia gardnerii Ludlow, 1905
Stegomyia albopicta (Skuse, 1895)
Stegomyia novalbopicta (Barraud, 1931)
Stegomyia patriciae (Mattingly, 1954)
Stegomyia pseudalbopicta Borel, 1928
Stegomyia subalbopicta (Barraud, 1931)
Stegomyia unilineata (Theobald, 1906)
Stegomyia krombeini (Huang, 1975)
Stegomyia malayensis (Colless, 1962)
Stegomyia scutellaris (Walker, 1858)
Genus *Udaya* Thurman, 1954
Udaya argyrurus (Edwards, 1934)
Udaya subsimilis (Barraud, 1927)
Genus *Tewarius* Reinert, 2006
Tewarius agastyai (Tewari & Hiriyan, 1992)
Tewarius nummatus (Edwards, 1923)
Tewarius reubenae (Tewari & Hiriyan, 1992)
Genus *Verrallina* Theobald, 1903
Subgenus *Harbachius* Reinert, 1999
Verrallina (*Harbachius*) *abdita* (Barraud, 1931)
Verrallina (*Harbachius*) *consonensis* (Reinert, 1973)
Verrallina (*Harbachius*) *uniformis* (Theobald, 1910)
Verrallina (*Harbachius*) *yusafi* (Barraud, 1931)
Subgenus *Neomacleaya* Theobald, 1907
Verrallina (*Neomacleaya*) *agrestis* (Barraud, 1931)
Verrallina (*Neomacleaya*) *andamanensis* (Edwards, 1922)
Verrallina (*Neomacleaya*) *assamensis* Bhattacharyya, Tewari, Prakash, Mohapatra & Mahanta, 2004
Verrallina (*Neomacleaya*) *atria* (Barraud, 1928)
Verrallina (*Neomacleaya*) *cauta* (Barraud, 1928)
Verrallina (*Neomacleaya*) *ceylonica* (Edwards, 1917)
Verrallina (*Neomacleaya*) *clavata* (Barraud, 1931)
Verrallina (*Neomacleaya*) *comata* (Barraud, 1931)
Verrallina (*Neomacleaya*) *indica* (Theobald, 1907)
Verrallina (*Neomacleaya*) *pseudodiurna* (Theobald, 1910)
Verrallina (*Neomacleaya*) *pseudomediofasciata* (Theobald, 1910)
Verrallina (*Neomacleaya*) *rami* (Barraud, 1928)
Verrallina (*Neomacleaya*) *seculata* (Menon, 1950)
Verrallina (*Neomacleaya*) *unca* (Theobald, 1901)
Verrallina (*Neomacleaya*) *vallistris* (Barraud, 1928)
Verrallina (*Neomacleaya*) *yerburyi* (Edwards, 1917)
Subgenus *Verrallina* Theobald, 1903
Verrallina (*Verrallina*) *butleri* (Theobald, 1901)
Verrallina (*Verrallina*) *dux* (Dyar & Shannon, 1925)
Verrallina (*Verrallina*) *lugubris* (Barraud, 1928)
Tribe Culicini
Genus *Culex* Linnaeus, 1758
Subgenus *Culex* Linnaeus, 1758
Pipiens Group
Culex (*Culex*) *nilgiricus* Edwards, 1916
Pipiens Subgroup
Culex (*Culex*) *quinquefasciatus* Say, 1823
Theileri Subgroup
Culex (*Culex*) *theileri* Theobald, 1903
Trifilatus Subgroup
Culex (*Culex*) *hutchinsoni* Barraud, 1924
Culex (*Culex*) *vagans* Wiedemann, 1828
Univittatus Subgroup
Culex (*Culex*) *fuscocephala* Theobald, 1907
Culex (*Culex*) *perexiguus* Theobald, 1903
Sitiens Group
Barraudi Subgroup
Culex (*Culex*) *barraudi* Edwards, 1922
Culex (*Culex*) *edwardsi* Barraud, 1923
Gelidus Subgroup
Culex (*Culex*) *gelidus* Theobald, 1901
Mimeticus Subgroup
Culex (*Culex*) *jacksoni* Edwards, 1934
Culex (*Culex*) *mimeticus* Noe, 1899
Culex (*Culex*) *mimuloides* Barraud, 1924
Culex (*Culex*) *mimulus* Edwards, 1915
Culex (*Culex*) *murrelli* Lien, 1968

Appendix 1. *Continued.*

Sitiens Subgroup
Culex (*Culex*) *sitiens* Wiedemann, 1828
Culex (*Culex*) *whitmorei* (Giles, 1904)
Vishnui Subgroup
Culex (*Culex*) *alienus* Colless, 1957
Culex (*Culex*) *pseudovishnui* Colless, 1957
Culex (*Culex*) *perplexus* Leicester, 1908
Culex (*Culex*) *tritaeniorhynchus* Giles, 1901
Culex (*Culex*) *vishnui* Theobald, 1901
Culex (*Culex*) *whitei* Barraud, 1923

Subgenus *Culiciomyia* Theobald, 1907
Fragilis Group
Culex (*Culiciomyia*) *fragilis* Ludlow, 1903
Culex (*Culiciomyia*) *nigropunctatus* Edwards, 1926
Culex (*Culiciomyia*) *pallidothorax* Theobald, 1905
Culex (*Culiciomyia*) *ramakrishnii* Wattal & Kalra, 1965
Culex (*Culiciomyia*) *scanloni* Bram, 1967
Culex (*Culiciomyia*) *spathifurca* (Edwards, 1915)
Culex (*Culiciomyia*) *viridiventer* Giles, 1901
Shebbearei Group
Culex (*Culiciomyia*) *bailyi* Barraud, 1934
Culex (*Culiciomyia*) *shebbearei* Barraud, 1924

Subgenus *Eumelanomyia* Theobald, 1909
Mochthogenes Group
Foliatus Subgroup
Culex (*Eumelanomyia*) *foliatus* Brug, 1932
Hinglungensis Subgroup
Culex (*Eumelanomyia*) *castrensis* Edwards, 1922
Culex (*Eumelanomyia*) *hinglungensis* Chu, 1957
Iphis Subgroup
Culex (*Eumelanomyia*) *iphis* Barraud, 1924
Khazani Subgroup
Culex (*Eumelanomyia*) *khazani* Edwards, 1922
Malayi Subgroup
Culex (*Eumelanomyia*) *malayi* (Leicester, 1908)
Pluvialis Subgroup
Culex (*Eumelanomyia*) *pluvialis* Barraud, 1924
Tenuipalpis Subgroup
Culex (*Eumelanomyia*) *tenuipalpis* Barraud, 1924
Culex (*Eumelanomyia*) *mohani* Sirivanakarn, 1977
Protomelanoconion Group
Culex (*Eumelanomyia*) *brevipalpis* (Giles, 1902)

Subgenus *Lophoceraomyia* Theobald, 1905
Fraudatrix Group
Fraudatrix Subgroup
Cinctellus complex
Culex (*Lophoceraomyia*) *cinctellus* Edwards, 1922
Quadripalpis complex
Culex (*Lophoceraomyia*) *aculeatus* Colless, 1965
Culex (*Lophoceraomyia*) *paraculeatus* Sirivanakarn, 1977
Culex (*Lophoceraomyia*) *quadripalpis* (Edwards, 1914)
Rubithoracis complex
Culex (*Lophoceraomyia*) *rubithoracis* (Leicester, 1908)
Seniori complex
Culex (*Lophoceraomyia*) *seniori* Barraud, 1934
Variatus complex
Culex (*Lophoceraomyia*) *cubitatus* Colless, 1965
Culex (*Lophoceraomyia*) *gracicornis* Sirivanakarn, 1977
Culex (*Lophoceraomyia*) *variatus* (Leicester, 1908)
Culex (*Lophoceraomyia*) *macdonaldi* Colless, 1965
Inculus complex
Culex (*Lophoceraomyia*) *inculus* Colless, 1965
Minutissimus Subgroup
Culex (*Lophoceraomyia*) *minutissimus* (Theobald, 1907)
Culex (*Lophoceraomyia*) *infantulus* Edwards, 1922
Mammilifer Group
Mammilifer Subgroup
Flavicornis complex
Culex (*Lophoceraomyia*) *flavicornis* Barraud, 1924
Culex (*Lophoceraomyia*) *lasiopalpis* Sirivanakarn, 1977
Culex (*Lophoceraomyia*) *raghavanii* Rahman, Chowdhury & Kalra, 1968
Singhbhumensis complex
Culex (*Lophoceraomyia*) *singhbhumensis* Natarajan & Rajavel, 2009
Mammilifer complex
Culex (*Lophoceraomyia*) *mammilifer* (Leicester, 1908)
Culex (*Lophoceraomyia*) *demissus* Colless, 1965
Culex (*Lophoceraomyia*) *wardi* Sirivanakarn, 1977
Traubi complex
Culex (*Lophoceraomyia*) *uniformis* (Theobald, 1905)

Appendix 1. *Continued.*

Minor complex
Culex (*Lophoceraomyia*) *bengalensis* Barraud, 1934
Culex (*Lophoceraomyia*) *bicornutus* (Theobald, 1910)
Culex (*Lophoceraomyia*) *minor* (Leicester, 1908)
Peytoni complex
Culex (*Lophoceraomyia*) *peytoni* Bram & Rattanarithikul, 1967
Pholeter complex
Culex (*Lophoceraomyia*) *pholeter* Bram & Rattanarithikul, 1967
Wilfredi Group
Culex (*Lophoceraomyia*) *pilifemoralis* Wang & Feng, 1964
Culex (*Lophoceraomyia*) *wilfredi* Colless, 1965
Subgenus *Maillotia* Theobald, 1907
Hortensis Group
Culex (*Maillotia*) *hortensis* Ficalbi, 1889
Subgenus *Oculeomyia* Theobald, 1907
Bitaeniorhynchus Complex
Culex (*Oculeomyia*) *bitaeniorhynchus* Giles, 1901
Culex (*Oculeomyia*) *infula* Theobald, 1901
Culex (*Oculeomyia*) *luzonensis* Sirivanakarn, 1976
Sinensis Complex
Culex (*Oculeomyia*) *cornutus* Edwards, 1922
Culex (*Oculeomyia*) *epidesmus* (Theobald, 1910)
Culex (*Oculeomyia*) *sinensis* Theobald, 1903
Genus *Lutzia* Theobald, 1903
Subgenus *Metalutzia* Tanaka, 2000
Lutzia (*Metalutzia*) *agranensis* Singh & Prakash, 2008
Lutzia (*Metalutzia*) *fuscana* Wiedemann, 1820
Lutzia (*Metalutzia*) *halifaxii* Theobald, 1903
Lutzia (*Metalutzia*) *vorax* Edwards, 1921
Tribe Culisetini
Genus *Culiseta* Felt, 1904
Subgenus *Allotheobaldia* Brolemann, 1919
Culiseta (*Allotheobaldia*) *longiareolata* (Macquart, 1838)
Subgenus *Culiseta* Felt, 1904
Culiseta (*Culiseta*) *alaskaensis* (Ludlow, 1906)
Culiseta (*Culiseta*) *niveitaeniata* (Theobald, 1907)
Tribe Ficalbiini
Genus *Ficalbia* Theobald, 1903
Ficalbia minima (Theobald, 1901)
Genus *Mimomyia* Theobald, 1903
Subgenus *Etorleptiomyia* Theobald, 1904
Mimomyia (*Etorleptiomyia*) *luzonensis* (Ludlow, 1905)
Subgenus *Mimomyia* Theobald, 1903
Mimomyia (*Mimomyia*) *aurea* (Leicester, 1908)
Mimomyia (*Mimomyia*) *chamberlaini* Ludlow, 1904
Mimomyia (*Mimomyia*) *hybrida* (Leicester, 1908)
Mimomyia (*Mimomyia*) *intermedia* (Barraud, 1929)
Subgenus *Ingramia* Edwards, 1912
Mimomyia (*Ingramia*) *fusca* (Leicester, 1908)
Tribe Hodgesiini
Genus *Hodgesia* Belkin, 1962
Hodgesia bailyi Barraud, 1929
Tribe Mansoniini
Genus *Coquillettidia* Dyar, 1905
Subgenus *Coquillettidia* Dyar, 1905
Coquillettidia (*Coquillettidia*) *crassipes* (van der Wulp, 1881)
Coquillettidia (*Coquillettidia*) *novochracea* (Barraud, 1927)
Coquillettidia (*Coquillettidia*) *ochracea* (Theobald, 1903)
Genus *Mansonia* Blanchard, 1901
Subenus *Mansonioides* Theobald, 1907
Mansonia (*Mansonioides*) *annulifera* (Theobald, 1901)
Mansonia (*Mansonioides*) *dives* (Schiner, 1868)
Mansonia (*Mansonioides*) *indiana* Edwards, 1930
Mansonia (*Mansonioides*) *uniformis* (Theobald, 1901)
Tribe Orthopodomyiini
Genus *Orthopodomyia* Belkin, Heinemann & Page, 1970
Orthopodomyia albipes Leicester, 1904
Orthopodomyia anopheloides (Giles, 1903)
Orthopodomyia andamanensis Barraud, 1934
Orthopodomyia flavicosta Barraud, 1927
Orthopodomyia flavithorax Barraud, 1927
Tribe Sabethini
Genus *Malaya* Leicester, 1908
Malaya genurostris Leicester, 1908
Malaya jacobsoni (Edwards, 1930)
Genus *Topomyia* Leicester, 1908
Subgenus *Suaymyia* Thurman, 1959
Topomyia (*Suaymyia*) *cristata* Thurman, 1959
Subgenus *Topomyia* Leicester, 1908
Topomyia (*Topomyia*) *bifurcata* Dong, Wang & Lu, 1995

Appendix 1. *Continued.*

Topomyia (*Topomyia*) *aureoventer* (Theobald, 1910)
Topomyia (*Topomyia*) *hirtusa* Gong, 1989
Genus *Tripteroides* Giles, 1904
Subgenus *Rachionotomyia* Theobald, 1905
Tripteroides (*Rachionotomyia*) *affinis* (Edwards, 1913)
Tripteroides (*Rachionotomyia*) *aranoides* (Theobald, 1901)
Tripteroides (*Rachionotomyia*) *coonorensis* Mattingly, 1981
Tripteroides (*Rachionotomyia*) *edwardsi* (Barraud, 1929)
Tripteroides (*Rachionotomyia*) *serratus* (Barraud, 1929)
Subgenus *Tripteroides* Giles, 1904
Tripteroides (*Tripteroides*) *indicus* (Barraud, 1929)
Tripteroides (*Tripteroides*) *similis* (Leicester, 1908)
Tripteroides (*Tripteroides*) *tarsalis* Delfinado & Hodges, 1968
Tribe Toxorhynchitini
Genus *Toxorhynchites* Theobald, 1901
Subgenus *Toxorhynchites* Theobald, 1901
Toxorhynchites (*Toxorhynchites*) *albipes* (Edwards, 1922)
Toxorhynchites (*Toxorhynchites*) *edwardsi* (Barraud, 1924)
Toxorhynchites (*Toxorhynchites*) *gravelyi* (Edwards, 1921)
Toxorhynchites (*Toxorhynchites*) *kempi* (Edwards, 1921)
Toxorhynchites (*Toxorhynchites*) *klossi* (Edwards, 1921)
Toxorhynchites (*Toxorhynchites*) *metallicus* Leicester, 1904
Toxorhynchites (*Toxorhynchites*) *minimus* (Theobald, 1905)
Toxorhynchites (*Toxorhynchites*) *splendens* (Wiedemann, 1819)
Toxorhynchites (*Toxorhynchites*) *tyagii* Krishnamoorthy *et al*., 2013
Tribe Uranotaeniini
Genus *Uranotaenia* Lynch Arribalzaga, 1891
Subgenus *Pseudoficalbia* Theobald, 1912
Section A
Bicolor series
Uranotaenia (*Pseudoficalbia*) *atra* Theobald, 1905
Uranotaenia (*Pseudoficalbia*) *bicolor* Leicester, 1908
Uranotaenia (*Pseudoficalbia*) *lutescens* Leicester, 1908
Uranotaenia (*Pseudoficalbia*) *obscura* Edwards, 1915
Bimaculata Series
Uranotaenia (*Pseudoficalbia*) *nivipleura* Leicester, 1908
Uranotaenia (*Pseudoficalbia*) *novobscura* Barraud, 1934
Recondita Series
Uranotaenia (*Pseudoficalbia*) *dibrugarhensis* Bhattacharyya, Prakash, Mohapatra & Mahanta, 2004
Uranotaenia (*Pseudoficalbia*) *husaini* Qutubuddin, 1947
Uranotaenia (*Pseudoficalbia*) *luteola* Edwards, 1934
Uranotaenia (*Pseudoficalbia*) *maculipleura* Leicester, 1908
Uranotaenia (*Pseudoficalbia*) *mattinglyi* Qutubuddin, 1951
Uranotaenia (*Pseudoficalbia*) *recondita* Edwards, 1922
Uranotaenia (*Pseudoficalbia*) *ohamai* Tanaka, Mizusawa & Saugstad, 1975
Uranotaenia (*Pseudoficalbia*) *stricklandi* Barraud, 1926
Section B
Maxima Series
Uranotaenia (*Pseudoficalbia*) *maxima* Leicester, 1908
Subgenus *Uranotaenia* Lynch Arribalzaga
Uranotaenia (*Uranotaenia*) *alboannulata* (Theobald, 1905)
Uranotaenia (*Uranotaenia*) *annandalei* Barraud, 1926
Uranotaenia (*Uranotaenia*) *campestris* Leicester, 1908
Uranotaenia (*Uranotaenia*) *christophersi* Barraud, 1926
Uranotaenia (*Uranotaenia*) *edwardsi* Barraud, 1926
Uranotaenia (*Uranotaenia*) *hebes* Barraud, 1931
Uranotaenia (*Uranotaenia*) *lateralis* Ludlow, 1905
Uranotaenia (*Uranotaenia*) *longirostris* Leicester, 1908
Uranotaenia (*Uranotaenia*) *micans* Leicester, 1908
Uranotaenia (*Uranotaenia*) *macfarlanei* Edwards, 1914
Uranotaenia (*Uranotaenia*) *orientalis* Barraud, 1926
Uranotaenia (*Uranotaenia*) *rutherfordi* Edwards, 1922
Uranotaenia (*Uranotaenia*) *testacea* Theobald, 1905